

CERTAIN RELATIONSHIPS BETWEEN SCHOLARSHIP IN HIGH SCHOOL AND IN COLLEGE

BY
LENA JAMES HAWKS

A DISSERTATION

submitted to the Board of University Studies of The Johns Hopkins University in conformity
with the requirements for the degree of Doctor of Philosophy

JUNE, 1929

BALTIMORE
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CHAPTER I

NEED FOR THE STUDY

The unprecedented increase in enrollment in the American schools in the last twenty-five years has brought many problems to every school administrator. The college has been faced with its full share, by no means the least of which has been the question of admissions.

A generation ago a college education was more or less a luxury; now, apparently, it has become a necessity; then it was enjoyed by the leisure class; now its privileges are demanded by everyone.

Even if the philosophy of the American educator conceded that a college education is desirable for every person, it is a physical impossibility to admit all students who apply. The college finds itself unprepared to cope with the situation. Reorganization in all directions is necessary and this is being done as rapidly as possible. In the meantime, a paramount question is that of selecting the student to be admitted to the college as it is today.

Efficient administration would demand a more careful selection than has been practiced. This is evidenced by the following statement of conditions at Leland Stanford University;¹ "During 1920-21 thirty per cent of the student population was placed on probation or disqualified for poor work. Three hundred and fifty thousand dollars a year, one-third of Stanford's instructional budget, was spent in the attempt to educate unsatisfactory or doubtful material. In 1924 one thousand three hundred and sixty-eight applicants took examinations to fill 803 places."

¹ Terman, L. M., and Cowdrey, K. M.: Stanford's Program of University Personnel Research. *Journal of Personnel Research*, Vol. 4, 1925-26, p. 263.

Not only is there waste in attempting to educate those who cannot or will not take advantage of their opportunities but many who would be an asset to the college population are not reached.² "If we could reduce the enrollment of those who can afford a college education but who cannot profit by it, and at the same time increase the enrollment of those who can greatly profit by a college education but cannot afford it, we should have made a real contribution to a more satisfactory scheme of educational guidance."

CONDITIONS AT THE JOHNS HOPKINS UNIVERSITY

Conditions in The Johns Hopkins University College of Arts and Sciences are indicated in Table I. At this University³ marks "are used by the instructor to represent his opinion of the general quality of the student's work and attainment in the course, in accordance with the following scale; 10 signifies excellent, 9 very good, 8 good, 7 fair, 6 passed. A mark of 5.5 constitutes a conditional failure; a mark of 5 or less constitutes a failure."⁴ A student who at any time has on his record three failures, ceases to be a member of the college. Any failure or conditional failure reported on the most recent official report or any previous report, counts as one of these, unless it has been absolved in the prescribed manner." Such students form the first class in the table and are indicated by dropped. The second class includes every student who voluntarily withdrew from the University with one or two failures on his record, or before the first semester grades were completed. Certainly such students are not satisfactory and hamper efficient administration. The third class is the sum of the two groups and constitutes the total per cent of unsatisfactory students.

² Patterson, Donald G.: *The Limitations of Scientific Method in Educational Guidance*. Vocational Guidance Magazine, Vol. 4, 1925, p. 15.

³ The Johns Hopkins University Circular; The College of Arts and Sciences 1928-29, pp. 39-42.

⁴ This rating scheme was changed in 1930-31. Three marks are now given: "H" for honor students; "S" for students of more than just passing calibre; "F" for border-line and failure cases.

TABLE I
PER CENT OF UNSATISFACTORY STUDENTS IN THE JOHNS
HOPKINS UNIVERSITY COLLEGE OF ARTS AND SCIENCES,
1924, 1925, AND 1926

	1924	1925	1926
Per cent dropped	23	21	16
Per cent withdrew	19	17	13
Per cent unsatisfactory	42	38	29

It may be noted that there has been improvement each year, but the condition is far from satisfactory.

CHAPTER II

STATEMENT OF THE PROBLEM

Three factors are recognized as largely effective in bringing about success in college. These are :

1. Native capacity.
2. Previous preparation.
3. Certain personal traits as interest, seriousness of purpose, ambition, temperament.

The measurement of these factors and weighting them to predict college success has been the objective in many recent studies. This study is concerned with the second one of these.

In attempting to evaluate the high school record as a basis for predicting college success, we shall search for answers to the two questions :

1. What subjects taken in the high school and what combinations of these subjects form the most effective basis for predicting scholastic success in college, and how shall the high school record be handled for this purpose?
2. Can college success be predicted from a record of the last three years in high school as well as from the entire four-year record?

The second one of these questions, while a legitimate phase of the first one, demands, perhaps, separate treatment because of the rapidly changing nature of secondary education in the reorganization on the 6-3-3 basis. During this reorganization, probably there has not been as much change made in the curriculum, method of teaching and the like in the senior high school as has occurred in the junior high school, with its try-out courses and its varied curricula preparatory to the different types of high schools. What is the relation of the last year of junior high school, or ninth-grade record to col-

lege scholarship? In 1925 Proctor,¹ in an address before The California High School Principals' Convention, advised "that since the College Entrance Examination Board selects only 8 units (in comprehensive examination) that the twelve units of senior high school could be accepted for college entrance." The answer to this second question should help to decide the matter.

Several of the more recent studies in the field are discussed in a later chapter. One noticeable feature in all of these is their lack of agreement as to results. In treatment two general characteristics appear: (a) either a single coefficient of correlation is found between the high school record and college grades or (b) when a number of coefficients are found these show a wide range of variation. In neither case is it possible to draw conclusions nor to make generalizations.

Again, in most of these studies either the entire high school record is compared with average scholarship in college, or the standing in each high school subject is compared with individual subjects in college. Not often has the standing in each high school subject been compared with the average standing in college, which is a problem of this study.

Apparently much of the work in recent years has been either to determine the relative prognostic value of intelligence tests and high school grades or the value of a combination of these two. Certainly the high school record is an indication of what a student may be expected to do in college. As early as 1910 Dearborn² made the statement that there is "excellent evidence that high school efficiency is highly correlated with university proficiency." However, he made no statistical treatment of his data so that it could be used for prognosis. Jones³ considers the "high school record of value

¹ Proctor, W. M.: *The High School's Interest in Methods of Selecting Students for College Admission*, School and Society, Vol. 22, 1925, p. 445.

² Dearborn, W. F.: *School and University Grades Wisconsin University*, Bulletin No. 368, 1910.

³ Jones, E. S.: *Predictions from High School Performances*, School and Society, Vol. 27 1928, pp. 339-340.

as it covers endeavor over a long period of time, measures more than brilliance or alertness. It depends mainly on the habits of work a student has established and the attitude of the student himself and also his family toward school."

Symonds⁴ in 1928, made the statement that "of all the indices of ability to do college work, marks in the high school course are the most significant. They are also the easiest for a college to obtain. Colleges should use the quality of work done in high school as the first index of college ability."

With the belief in the prognostic value of the high school record as evidenced in these statements, it seems possible that additional work in the method of handling this record is desirable. Odell⁵ makes the statement, "combining the evidence from all studies along this line with which the writer is familiar the statement seems warranted that in general a score on any one of the best intelligence tests and the proper high school mark have about equal value in predicting probable freshman marks. In each case the general expectation concerning the size of the coefficient of correlation is that it will be somewhere between .40 and .50, although under the best conditions one can reasonably expect to secure at least some simple correlations of .60 or higher." Again he writes: "Multiple correlations are discouraging, but the writer wishes to emphasize as strongly as possible the need for further experimentation and investigation, especially along the line of determining which criteria form the best combination for prediction based upon multiple correlation and the regression equation." He believes that "a combination of the score upon one of our best intelligence tests, of the marks in certain high school subjects, of the ratings of study habits and perhaps of other factors, can be so made that practically any institution can obtain correlations of .75 or .80 between the marks of its students and the best available combinations."

⁴ Symonds, P. M.: *Measurement in Secondary Education*, New York City, Macmillan Co., 1928.

⁵ Odell, C. W.: *Predicting the Scholastic Success of College Freshmen*, Urbana, Ill., Bureau of Educational Research, Bulletin No. 37, 1927.

Cleeton^{*} thinks there are three ways of increasing accuracy of prediction: (1) by securing other criteria to supplement scholarship records, (2) by supplementing measuring devices of capacity now in use with radically different measures, and (3) by improving the predictive value of existing measures, or to prepare some of higher degree of differential sensitivity.

With the above statements in mind, the questions at the beginning of this chapter were set up.

^{*} Cleeton, Glen U.: The Predictive Value of Certain Measures of Ability in College Freshmen," *Journal of Educational Research*, Vol. 15, 1927 pp. 357-370.

CHAPTER III

DATA AND OUTLINE OF SOLUTION

To answer the questions set up in the preceding chapter the following data have been secured :

1. *The High School Record*

This includes the numerical grade on each subject studied for each year during the four years in secondary school. It includes the third of the graduating class in which the student's grades place him, and both the passing and the college certificating grade of the high school.

2. *The College Record*

This includes the semester grades in each subject for the freshman year. In the case of The Johns Hopkins University it includes all grades made by each student during his entire residence at the University.

The procedure used has been applied to three situations : (1) The Johns Hopkins University, (2) Gettysburg College, and (3) Vanderbilt University. For the first, students entering college in the fall of 1924, of 1925, and of 1926, have been studied ; for 1924 those entering the College of Arts and Sciences, for the other two years those entering both the College of Arts and Sciences and that of Engineering. At Gettysburg College those entering the College of Arts and Sciences in the fall of 1926 and at Vanderbilt those entering the same school in the fall of 1927.

The second of the questions set up will be studied in a later chapter. We now proceed to an investigation of the first. Its solution will be attempted according to the following outline of the treatment of the data :

1. Average high school marks by subjects and by years.
2. Average college marks by semesters and by years.
3. Evaluate the high school passing grade.

4. Calculate correlation coefficients :
 - a. Between marks on each high school subject and scholarship average in college.
 - b. Between combinations of high school subjects and college scholarship.
 - c. Between high school average and college scholarship.
 - d. Between high school subjects.
 - e. Multiple coefficients between various combinations of high school subjects and college scholarship.
5. Compare these results and determine the best method of handling the high school record.

CHAPTER IV

DEFINITIONS AND TREATMENT OF DATA

SELECTION OF SCHOLASTIC SUCCESS

College Success, in this study, is interpreted as scholastic success. No one fails to recognize that scholastic is not the only type of success. Much has been written both popularly and professionally on this subject. But the fact remains that college grades form the basis for college promotions, honors, and in many cases further recommendations. In defense of the use of teachers' marks as a criterion for determining college success Abelson¹ says:

1. They are the only feasible measures.
2. They are used at the present time as the basis of promotion, acceleration, graduation and honoring students, etc.
3. They are in line with the present aim of the college, academic and restricted as it may be.
4. This criterion undoubtedly correlates fairly high with the truest criterion, and since comparison of the items rather than the determination of absolute values are aimed at, it is likely that the results would remain the same with respect to the truest criterion.

Toops² concludes that the search for the "test that will predict college marks" will continue until we shall have a better substitute for college marks as a measure of college success.

The objectivity of any measuring device is largely determined by its validity and reliability. Much has been written about the variability (and therefore unreliability) of teachers'

¹ Abelson, H. H.: The Improvement of Intelligence Testing, Teachers College, Columbia University Contribution to Education, No. 273, New York City, Teachers College Bureau of Publications 1927.

² Toops, H. A.: The Prediction of Scholastic Success in College, School and Society, Vol. 25, 1927, pp. 265-268.

marks. Perhaps as a result of the classic experiments where a number of teachers have been asked to grade a single effort of one student, the explanation usually offered for such a condition has been the subjective treatment by the teacher. This does not explain the variability in student performance. Every college teacher knows that many factors influence student achievement from term to term in the same subject and in general average. Often a student to raise his standing in one subject will neglect another in which he has previously made a good record, or extra-curricular activities at one season may lower his entire average from that of a previous season.

RELIABILITY OF THE JOHNS HOPKINS UNIVERSITY MARK

The marking system at The Johns Hopkins University has been explained previously. The conditions which, in this study, characterize success (or the ability to remain in college) may be measured by the cumulative grade at the end of any period.

If scholastic success in college is measured by teachers' marks, with what consistency is this done? Whether or not teachers' marks are valid is another question, but whatever it is they measure, are the results comparable from time to time, in other words are they reliable measures? This is determined by getting the coefficients of correlation between teachers' marks for various intervals during the college course. These coefficients (shown in Table II) range from .864 to .975, four of the six being above .93.

TABLE II
COEFFICIENTS OF CORRELATION BETWEEN TEACHERS' MARKS
OF STUDENTS ENTERING COLLEGE OF ARTS AND SCIENCES
IN 1925-'26

$N = \text{about } 90$

	1925		1926	
	1st yr.	Average 3 yrs.	1st yr.	Average 2 yrs.
1st semester	.932	.891	.975	.864
1st year	....	.939	....	.938

Attention should be called to the fact that these coefficients are not based on entirely independent factors (such as 1st semester marks and 2nd semester marks) and therefore are undoubtedly higher than they would be if based on independent factors. But we are not so much interested in how well the first semester record will predict the second semester as in how well the first semester record will predict the entire record of the first year or of the first two years. For it is on a cumulative record that the student is dropped.

As here determined, the reliability of the grades at The Johns Hopkins University appear to be above the average of those reported in many published studies. For example, Kornhauser³ reported that at The University of Chicago coefficients between marks for the different quarters of the freshman year varied from .40 to .70, the coefficient between first year average and second year average was .68.

Cleaton⁴ stated that the reliability between the first and second semester grades at Carnegie Institute of Technology exceeded .80.

Toops⁵ in a study of 66 of the 110 American Universities, found that the average of the correlations between first term's and second term's grades was .66.

Table III indicates the reliability of college marks in the School of Engineering. By comparison with Table II, it will

TABLE III
COEFFICIENTS OF CORRELATION BETWEEN TEACHERS' MARKS, FOR
STUDENTS ENTERING THE SCHOOL OF ENGINEERING IN
1925 AND 1926

	1925		1926	
	Average 1st yr.	Average 3 yrs.	Average 1st yr.	Average 2 yrs.
1st semester average	.908	.889	.909	.703
1st year average	....	.759	....	.778

³ Kornhauser, A. W.: Test and High School Records as Indicators of Success in an Undergraduate School of Business, *Journal of Educational Research*, Vol. 16, 1927, pp. 342-356.

⁴ Cleaton, Glen U.: The Predictive Value of Certain Measures of Ability in College Freshmen, *Journal of Educational Research*, Vol. 15, 1927, pp. 357-370.

⁵ Toops, H. A.: The Uses of Intelligence Tests in 66 of 110 American Universities, Columbus, Ohio, *Ohio State University Bulletin*, 1926.

be seen that these coefficients of correlation are somewhat lower than those for marks in the College of Arts and Sciences from (.002 to .180). However, these compare favorably with those found at other colleges.

On the above evidence of the reliability of the college mark, the major portion of this study deals with the prediction of freshman success in college.

TREATMENT OF COLLEGE MARK

The Johns Hopkins University grants the degree of Bachelor of Arts or Bachelor of Science on the successful completion of the required courses, successful completion being interpreted as a passing grade or better. The college mark was transmuted to a percentage basis by multiplying by 10 and these percentages were used in finding the coefficients of correlation. The decision to use the percentage mark was based on a comparison of this mark with percentile rank in freshman average when the former was found to give a higher coefficient of correlation.

Freshman scholarship was found by computing the simple arithmetic average of the subjects taken during the freshman year, each subject being equally weighted. This seemed to give the best single measure of scholastic success.

TREATMENT OF HIGH SCHOOL MARK

The word high school is here used for any preparatory school, public or private, consisting of four years of secondary work, unless otherwise indicated, built on an eight grade elementary system.

A majority of the high schools use a percentage system in grading. If a literal system is used, when accompanied by numerical equivalents, the letters were changed to numbers, otherwise the record was not included in this study. The high school record was taken from the application submitted by the student. (A copy of this is in the appendix.) Simple

averages were derived here also, for each subject and for the yearly and four-year averages. In the general average each subject received equal weight. It did not appear necessary to attempt to weight each subject contributing to the average because any difference in the relative value would appear in finding multiple correlations.

To quote Odell again, "In conclusion, the writer is willing to hazard the prediction that similar studies, each including only students from one large high school to a single higher institution, and employing the Thorndike Test and certain subject matter examinations in addition to the high school marks, could be so planned that multiple coefficients for the whole freshman average and also for some subjects, as high as .80 or .85 could be obtained." A part of this study is an attempt to determine what is the highest predictive value that may be expected from a detailed and analytical study of the grading system of those high schools from which a single institution normally draws its patronage. If it is possible to improve the predictive value of the high school record, this should contribute to the predictive value of the combination.

The Johns Hopkins University attracts many students from two large secondary schools in Baltimore, known as the Baltimore City College and the Baltimore Polytechnic Institute, hereafter known as Schools A and B. This group of students has been studied separately and later in combination with all students who have been admitted to the University.

The first attempt to make all high school grades comparable was to accept at face value the passing grade of each high school and transmute all grades to a common passing basis. This overweighted, slightly, the grades in the upper range of those schools having a high passing mark, but apparently had little effect on the coefficients. In a majority of the cases there were not sufficient students from each of the above high schools to get any reliable standard measure such as standard deviation or percentile units.

Coefficients of correlation between these measures and college scholarship were found by the Pearson product-

moment method. From a study of the scatter diagrams new interpretations of the passing grade of each high school could be made and new coefficients of correlation determined. This is apparently a subjective method of rating the high schools but the rating is objectively measured, since coefficients of correlation are determined with each rating, and the rating contributing to the highest coefficient is used.

The question might arise as to the relative validity of the college and high school grades. It is often argued that the high school grade is more valid because the use of objective tests is more prevalent there than in the college. Be that as it may, to predict college grades, it is necessary to transmute the high school grade until it conforms to that in the college.

The final interpretation resulted in the following:

1. School A grades were used as such, the passing grade being 60%. This gave grades comparable with college grades.
2. Although School B uses 70% as a passing grade, for all years except the first where 60% is used, it was found that to use the grade appearing on the record when combining it with School A gave a higher coefficient than to change it to a 60% passing basis.
3. The passing grade of all public high schools in Maryland, outside of Baltimore City, was, in like manner located at 80%.
4. With one or two exceptions, several large private preparatory schools from which a number of students entered the University were assigned the passing grade indicated on the application.

After the passing grade for each school was determined, all grades were transmuted to a common passing basis, 60%, and thereafter used as such. For example, if 80% were the passing grade, the range between 80% and 100% was divided into 20 equal intervals. Likewise dividing the range between 60% and 100% into 20 equal intervals a table showing corresponding grades was calculated. Such tables were set up for each passing grade, making the transmutation of percentage scores a simple matter. Such a method produces the

same results as those used by other investigators. Kornhauser⁶ used the formula—

$$\frac{\text{Student's Mark}}{100} - \frac{\text{Passing grade}}{\text{Passing grade}} \text{ for transmuting.}$$

Cocking and Haly⁷ found a coefficient based on the several passing marks which was used as the multiplier with each high school mark. In all these cases the results would be exactly the same.

⁶ Kornhauser, A. W.: Test and High School Records as Indicators of Success in an Undergraduate School of Business. *Journal of Educational Research*, Vol. 16, 1927, pp. 342-356.

⁷ Cocking, W. D., and Haly, T. C.: The Relation of Intelligence Scores to High School and University Marks, *Educational Research Bulletin*, Vol. 6, 1927, pp. 383-4.

CHAPTER V
RELATIONSHIPS EXPRESSED BY SIMPLE COEFFICIENTS
OF CORRELATION

Recognized statistical devices on which prediction may be made are the coefficient of correlation, and the regression equation. As indicated previously several groups of students were studied separately. The bases of classification were:

1. Schools of the University.
2. Years of admission.
3. High schools in which students were prepared.

To make these divisions has greatly increased the work of this study, but it is hoped that by so doing a clearer understanding of the conclusions drawn may be afforded. In many studies of this kind it has been common to throw all grades into a single distribution depending upon numbers for reliability, and to base conclusions on a single coefficient of correlation. A statistical device for measuring the reliability of a coefficient of correlation is its probable error, whose value is largely determined by numbers. But disregarding the chances indicated by the probable error every one who has worked with coefficients of correlation, where mental functions are concerned, knows what a large part chance, or unrecognized factors, may play in the size of a single coefficient.

INDIVIDUAL HIGH SCHOOL SUBJECTS

Table IV shows the coefficients of correlation between average grades for the first semester and the first year in college and grades in high school on each subject presented for entrance and the average high school grade. Students from School A and School B are used alone and combined with those from all other schools. Probable errors are not indicated. No student was included in whose record there was the slightest discrepancy. After such were eliminated the

TABLE IV
COEFFICIENTS OF CORRELATION BETWEEN GRADES ON HIGH SCHOOL SUBJECTS AND AVERAGE COLLEGE SCHOLARSHIP
FOR 1ST SEMESTER AND FOR 1ST YEAR, JOHNS HOPKINS UNIVERSITY, COLLEGE OF ARTS AND SCIENCES

	1924			1925			1926		
	1st Sem.		1st Year	1st Sem.		1st Year	1st Sem.		1st Year
High School Subjects	Sch. A & B	All Schools	Sch. A & B	Sch. A & B	All Schools	Sch. A & B	Sch. A & B	All Schools	Sch. A & B
Mathematics	.649	.602	.617	.607	.584	.466	.604	.495	.707
English	.563	.612	.484	.570	.684	.578	.555	.517	.507
Latin	.587	.573	.501	.642	.665	.424	.644	.642	.633
French	.572	.632	.536	.581	.562	.513	.690	.487	.639
History	.580	.533	.542	.602	.643	.617	.529	.582	.496
Science	.505	.517	.550	.609	.627	.664	.570	.540	.583
Drawing	.020	....	.083	.098	....	.157	.508	....	....
High School Average	.690	.656	.601	.753	.766	.639	.717	.672	.716

The first line of this table should be read: "The coefficient of correlation between the grades earned in Mathematics during the high school course by students in School A and School B and first semester scholarship in 1924 is .649. The same coefficient based on the records of all students entering in 1924 is .602, etc.

average number, each year, from these two schools was about 40, from all schools, about 80. In addition to this the standard deviations and ranges are quite constant throughout so that comparison of these coefficients is possible.

Attention is called to several points resulting from a study of this table.

1. For students from Schools A and B, high school grades predict college grades at the end of the first semester better than at the end of the first year in every case except in Drawing and in Science in 1924, and in Drawing and in English in 1925. However, the average of the differences in the coefficients for first semester and first year is very little more than the probable error of the average coefficient for the first semester.

2. A comparison of the coefficients of correlation between high school marks and college marks shows that there is very little difference between those of the group from Schools A and B and those of the entire group. Of the seventy coefficients in twenty cases those of the first are higher than those of the second group, leaving but fifteen cases where those of the first group are lower. The difference however is slight.

3. With the exception of drawing the range of the coefficients is small. Omitting the high school average that for individual subjects is .42 to .70, with a mean of $.582 \pm .044$.

These coefficients are comparable with those found in recent studies, several of which are considered in a later chapter. A few of the results may be quoted here.

Bancroft Beatley¹ at Harvard using an average of the latest high school record in each subject found the coefficient between this average and first year college marks to be $.56 \pm .02$. He found the same coefficient when using second year college marks.

Ben D. Wood² at Columbia found the coefficient between high school average and first year college scholarship to be .331, when he used second year college scholarship .262.

¹ Beatley, Bancroft: *The Relative Standing of Students in Secondary School, the Comprehensive Entrance Examinations, and in College*, School Review, Vol. 30, 1922, pp. 141-147.

² Wood, Ben D.: *Measurement in Higher Education*, New York, World Book Co., 1923.

Gowen and Gooch³ at The University of Maine in 1925 calculated correlations between individual high school subjects and each of seven freshman college subjects. The averages of the coefficients between each high school subject and the seven college subjects⁴ range from .247 to .337.

Kornhauser⁵ in the undergraduate School of Business at Chicago University, in 1927 calculated, among others, coefficients of correlation between high school subjects and first year college scholarship. He found the following:

	English	History and Civics	Mathe- matics	Foreign language	Science
1st year College Scholarship	.41	.44	.46	.49	.54

The coefficients in Table IV are well above the averages indicated in these studies. However, attention must be called to the fact that with the exception of that of Kornhauser these are in a degree dissimilar in data and treatment. The averages of the ten coefficients, in Table IV, for each subject (20 in case of foreign language) are indicated below:

TABLE V

	English	History and Civics	Mathe- matics	Foreign language	Science	H. S. average
Average 1st year College Scholarship	.57	.59	.60	.59	.58	.69

Comparing these with Kornhauser's results it may be noted that:

- (a) Those of this study are well above those found by Kornhauser.
- (b) The variability of these is much less.

³ Gowen, J. W., and Gooch, M.: The Mental Attainments of College Students in Relation to Previous Training, *Journal of Educational Psychology*, Vol. 16, 1925, pp. 547-568.

⁴ For example, the average of the coefficients between high school Chemistry and each of the seven college subjects was .247.

⁵ Kornhauser, A. E.: Test and High School Records as Indicators of Success in an Undergraduate School of Business, *Journal of Educational Research*, Vol. 16, 1927, pp. 342-356.

- (c) In both cases high school English has the least value, of the five subjects, in predicting college success.
- (d) With this exception, there is no correspondence in the order of value of prediction.

It is just this sort of discrepancy among the studies made at different colleges that makes the prediction of college success so hazardous.

It is interesting to note that while Mathematics has the highest predictive value of scholarship in the College of Arts and Sciences at The Johns Hopkins University, this subject is overreached by both foreign language and science at the Chicago University School of Business.

4. In each case the high school average with college scholarship gives a higher coefficient than does any single subject which contributes to that average. One exception to this is in 1924 for students from Schools A and B the coefficient for high school average and first semester scholarship is .601 and that for Mathematics and first year scholarship is .617. This difference however is too small to be statistically significant. The average of these coefficients is .688 or .106 higher than the average of coefficients based on individual subjects.

5. The variation of the coefficients from year to year indicates that there is very little choice among the six academic subjects for predictive purposes.

COMBINATIONS OF HIGH SCHOOL SUBJECTS

In the preceding section attention was called to several facts which influence this part of the study.

1. That there is little difference between the value of high school marks in predicting the work of the first semester and that of the first year. Other things being equal, prediction of the first semester standing is much more desirable, from an administrative standpoint, than is the prediction of the first year's standing. Therefore, the first semester has been chosen for this part of the study.

2. That there would be but little difference in prediction based on marks from Schools A and B and from all schools. We shall see if this is true for combinations also.

3. That the high school average offers a better basis for prediction than does any single subject. We shall see if this holds good for combinations of subjects.

4. That the predictive value of individual subjects varies with years. To see if this variation obtains in a like degree for combinations we have selected 1925 and 1926.

To carry out this part of the investigation calculations were made of the average marks in all the high school subjects involved, with the exception of drawing, in groups of two and three by getting a simple average of the grades made in high school. A method of weighting somewhat in relation to the simple correlation of each with first semester scholarship might have been used, but since the differences in these coefficients are so small simple arithmetic averages were taken. Coefficients of correlation between these averages and first semester standing in college were calculated. These are shown in Table VI.

TABLE VI
COEFFICIENTS OF CORRELATION BETWEEN SIMPLE AVERAGES OF MARKS
MADE IN HIGH SCHOOL SUBJECTS AND FIRST SEMESTER
SCHOLARSHIP, JOHNS HOPKINS UNIVERSITY
COLLEGE OF ARTS AND SCIENCES

Simple averages, high school subjects	1925		1926	
	Schools A and B	All Schools	Schools A and B	All Schools
Mathematics and Science	.722	.721	.652	.670
Science and English	.709	.702	.659	.604
Mathematics, Science and English	.782	.758	.665	.651
Mathematics and English	.707	.705	.661	.665
English and History	.799	.745	.592	.540
Mathematics, English and History	.761	.743	.693	.649
Mathematics and Latin	.660	.740	.767	.764
Mathematics, Latin and Science	.727	.761	.742	.727
French and Science	.691	.587	.756	.692
French, Science and History	.760	.693	.743	.724
High School Average	.753	.766	.717	.716

The first line of this table should be read, The coefficient between a simple average of the grades made in high school on Mathematics and Science and first semester scholarship for students from Schools A and B is .722. The same coefficient for all students entering in 1925 is .721.

We note from this table that the coefficients based on simple averages of marks in two or three high school subjects com-

bined are quite a little higher than are those based on individual subjects. For example, from Schools A and B in 1925 the coefficient of correlation between Mathematics and first semester scholarship is .607, between Science and first semester scholarship is .699 while between Mathematics and Science combined and first semester the coefficient is higher than either, .722. This is true in all cases where two subjects are combined. Where three are combined the coefficient is raised even higher. For Mathematics, Science and English combined, the coefficient is .782, that for English alone is .570. This coefficient for the three combined is .083 higher than the highest coefficient of any one of the three individual subjects.

The greatest increase in any two subject combination is that for English and History in 1925, where the combination of the two gives a coefficient of .799, while that of English is .570 and that of History .692. This coefficient is higher than that given by the high school average.

When we examine the results for 1926 we note that, in general, the coefficients are lower, the exceptions being those that include foreign languages (seven out of the eight being above .72). All of the other coefficients are lower than that given by the high school average; again combinations of three subjects are better than combinations of two, with the exception of foreign languages.

The rank on size of the coefficients in the two years is almost in reverse order, the highest single coefficient in 1925 being that of English and History with first semester .799, which is the lowest single one in 1926, it being .592.

The lowest in 1925 is the combination of Mathematics and Latin with first semester scholarship .660 while this is the highest in 1926, it being .767. This indicates that a choice of subjects on which to base prediction is not possible. But, by no means, do these discrepancies tend to indicate that the high school record is not a very valuable basis on which to predict college success. Certainly an array of coefficients as high as those in Table VI show that there is a close relationship between achievement in high school and in college. The

danger comes in taking for granted that a college situation in any one year is a representative one.

Some of these discrepancies may be ironed out by taking an average of the two years. Such an average should be representative since in all cases the number and range are exactly the same and the standard deviations and means, very nearly the same. Table VII shows the averages of the coef-

TABLE VII
AVERAGES OF COEFFICIENTS IN TABLE VI FOR 1925 AND 1926

Simple averages, high school subjects	Schools A and B	All schools
Mathematics and Science	.687	.696
Science and English	.684	.653
Mathematics, Science and English	.723	.705
Mathematics and English	.684	.685
English and History	.696	.643
Mathematics, English and History	.727	.696
Mathematics and Latin	.714	.752
Mathematics, Latin and Science	.735	.744
French and Science	.724	.640
French, Science and History	.751	.709
High School Average	.735	.741

ficients for the two years for each of the two groups, Schools A and B, and all schools. Certainly any one of these averages would represent more accurately either one of the two years than either year would represent the other.

Again we note that with the exception of the combination of Mathematics, Science and English in "all schools" the combination of three subjects in every case gives a higher coefficient than the combination of two subjects, and that these coefficients compare favorably with that given by the high school average, which for Schools A and B is .735 and for "all schools" .741.

The following conclusions may be drawn:

1. The agreement of coefficients based on grades from Schools A and B and from all schools is more marked for combinations than for individual subjects, differences ranging from .001 to .074. This was to be expected, as, in general,

an average is more reliable than a single measure. This statement is borne out by the coefficient for high school average and scholarship.

2. In general, an average of three subjects is better than an average of two. They all compare favorably with the coefficient given by the high school average. Three out of the four combinations of three subjects yield coefficients higher than does the high school average.

CHAPTER VI

RELATIONSHIPS EXPRESSED BY MULTIPLE CORRELATIONS

"With established linearity the relation expressed by the regression equation is the most probable one that exists."¹

That number which represents the relation between the most accurately predicted and the actual measure is the multiple correlation coefficient. Table VIII gives the inter-

TABLE VIII

COEFFICIENTS OF CORRELATION BETWEEN SUBJECTS IN SCHOOLS
A AND B FOR 1925 AND 1926

1925	English	Science	Latin	History	French
Mathematics	.688	.633	.484	.550	....
English	....	.644	.517	.590	....
Science	....	....	.525	.657	.581
History	....	....	....	....	.543
1926					
Mathematics	.696	.797	.663	.690	....
English	....	.652	.634	.691	....
Science	....	....	.620	.558	.421
History	....	....	....	....	.636

correlations of subjects in Schools A and B for 1925 and 1926. These coefficients with those in Table IV for the same years form the bases for the determination of the multiple coefficients.

The method of determining the multiple coefficient of correlation will be explained in a later chapter. Just here we are interested in comparing these coefficients with those obtained from simple averages. This is set forth in Table IX. Column one indicates the subjects combined; column two, the coefficients between simple averages of marks on the combined high school subjects indicated and first semester scholarship; column three, coefficients of correlation of the subjects indicated when combined by multiple correlation technique. To illustrate, when a simple average of the high school marks on Mathematics and Science is correlated with first semester

¹ Kelley, T. L.: Statistical Method, New York, The Macmillan Company, 1923.

scholarship the coefficient is .722. When the marks on Mathematics and Science are weighted in the best manner, by multiple correlation technique, the weighted score and first semester scholarship give a coefficient of .731.

For purposes of comparison we have indicated these coefficients in parallel columns for 1925 and 1926.

Attention is called to the similarity of these two types of coefficients. Of the twelve coefficients based on combinations of two subjects, exactly half has the multiple coefficient lower than, or equal to, that based on a simple average. Five-eighths

TABLE IX

COEFFICIENTS OF CORRELATION BETWEEN FIRST SEMESTER SCHOLARSHIP AND HIGH SCHOOL SUBJECTS BASED ON SIMPLE AVERAGES AND MULTIPLE TECHNIQUE

H. S. subjects combined	1925		1926	
	Simple averages r	Multiple R	Simple averages r	Multiple R
Mathematics and Science	.722	.731	.652	.694
English and History	.799	.721	.592	.591
Mathematics and English	.707	.642	.661	.701
Science and English	.709	.717	.659	.620
Mathematics and Latin	.660	.726	.767	.735
French and Science	.691	.731	.756	.756
Mathematics, Science and English	.782	.733	.665	.699
Mathematics, English and History	.761	.733	.693	.701
Mathematics, Latin and Sci- ence	.727	.783	.742	.733
French, Science and His- tory	.760	.779	.693	.765

of the coefficients, where three subjects are combined, show the multiple correlation higher.

Although the coefficients for 1926 are in general lower than those for 1925, practically the same relations exist between the coefficients based on simple averages and those derived by the use of multiple technique. In 1925 the range of those on simple averages is .660-.799 with an average of .732, while the range of the multiple coefficients is .642-.783 with an average of .730. In 1926 the coefficients based on simple averages range from .592 to .767 with an average of .688, while the multiple coefficients range from .591 to .765 with an average of .700.

From the nature of the multiple correlation coefficient one might expect that these would be more consistent. In other words that the variations in the intercorrelations might take care of the variations from year to year. However, they are but slightly more consistent.

The range of the differences between coefficients based on averages for the years 1925 and 1926 is .015-.207, that for the multiple coefficients .014-.130. The difference in these two ranges is slight when we consider that 26 of the 40 coefficients are above .70.

From the results brought out in this table it is safe to conclude that, for predictive purposes, coefficients of correlation based on simple averages are as effective as regression coefficients.

SUMMARY

Just here we may summarize the conclusions noted up to this point.

1. There is no advantage in predicting from the grades made in one or two large high schools over a combination of all high schools, when the passing grade has been adjusted.
2. A relationship, represented by a coefficient of correlation of about .60 exists between scholarship on individual academic subjects taken in high school and college scholarship, in The Johns Hopkins University College of Arts and Sciences.
3. A relationship, represented by a coefficient of about .70, exists between average scholarship in high school and in college.
4. Apparently, standing in the non-academic subject, drawing, is not related to standing in college.
5. A simple arithmetic average of standing in any two academic subjects is more closely related to college scholarship than is standing in any one high school subject, and a simple average of standing in any three high school subjects is comparable with the high school average in relation to college standing.
6. Relationships based on simple averages are nearly the same as those based on the multiple correlation technique.

CHAPTER VII

RELATIONSHIPS FOUND IN OTHER INSTITUTIONS

As was indicated earlier, the procedure used at The Johns Hopkins University was applied in two other colleges:

A. Gettysburg College, Gettysburg, Pa.

B. Vanderbilt University, Nashville, Tenn.

Neither of these two colleges receive students in sufficient numbers from one or two high schools to make feasible a classification on this basis. Also, only students in the College of Arts and Sciences were studied, and a single class in each institution. Those students who entered Gettysburg in the fall of 1926, about 150 in number, were used in the first case; and those entering Vanderbilt in the fall of 1927, a similar number, were used in the second case. These two institutions will be considered separately.

A. GETTYSBURG COLLEGE

The system of grading at Gettysburg College is similar to that at The Johns Hopkins University, except that marks are recorded in letters, A-B-C-D-E-F. The first four of these are passing or above; E is a condition and F is a failure. By a consensus of opinion of faculty members the grade of D represents 60% to 70%, the three letters above D, divisions of 10 up to 100%. E represents a conditional failure which may be removed by examination and F an absolute failure, which may be removed only by repeating the course. According to this system all letters were given a percentage interpretation.

Since a student is asked to withdraw from the college when his record indicates two failures or one unabsolved condition and one failure, the reliability of the marking system was based on the correlation of first semester marks with first year marks. This coefficient was found to be .892.

The next step was to evaluate the high school marks. A majority of the students entering Gettysburg College are from the public high schools, the only other institution sending an appreciable number is Gettysburg Academy.

One basis of classification of public high schools in Pennsylvania is the population of a district.¹ Each school district having a population of 500,000 or more is a district of the first class. Each school district having a population between 30,000 and 500,000 is a district of the second class, between 5,000 and 30,000 a district of the third class, and less than 5,000 a district of the fourth class.

All high schools involved were classified on this basis. Then from the classification of secondary schools by the State Department² the type of organization and the number of teachers and enrollment of each school was determined. With this information an adjustment of the high school passing grade (in most cases 70%) was made according to the following:

1. The passing grade of all schools of the first and second classes was used at face value.

2. The same was true of schools in the third class with the exception of those in which the enrollment showed more than thirty pupils to each full-time teacher. Under such conditions the passing grade was raised to 80%.

3. In the fourth class, if there were more than five teachers the passing grade was raised from 70% to 75% or from 75% to 80%, if there were fewer than five teachers the grade was raised from 70% to 80%. In no case was a passing grade raised above 80%.

After this adjustment of the passing grade, all marks were transmuted to a common basis, 60% being chosen because it made these comparable with the college marks. The value of this adjustment was shown by the correlations between high school average and first semester scholarship before and after making, the first being .528, the second, .637.

¹ Commonwealth of Pennsylvania Department of Public Instruction, *The School Law*, Harrisburg, Pa., 1925.

² Commonwealth of Pennsylvania, Department of Public Instruction, *Classification of Secondary Schools*, 1926-27, Bulletin 27, Harrisburg, Pa., 1927.

TABLE X

COEFFICIENTS OF CORRELATION BETWEEN HIGH SCHOOL AVERAGES AND
FIRST SEMESTER SCHOLARSHIP IN GETTYSBURG COLLEGE $N = \text{about } 105$

	English	History	Mathe- matics	Latin	French	Science	H. S. average
1st Sem- ester, Average	.543	.538	.615	.519	.401	.605	.637

Comparing these coefficients with averages previously given in Table V, we find a close correspondence, the coefficients for mathematics .615 and science .605 at Gettysburg being slightly larger than average coefficients for these subjects .60 and .58 respectively, at The Johns Hopkins, and that of foreign language .460 smaller than that at The Johns Hopkins .59. With the exception of the last named the order of subjects in size of coefficients is about the same.

In Table XI are given the intercorrelations of high school subjects for students at Gettysburg College and in Table XII

TABLE XI

INTERCORRELATIONS OF HIGH SCHOOL SUBJECTS

	English	Science	History	Latin
Mathematics	.645	.758	.658	.707
English	....	.709	.763	.634
Science	....	....	....	.720

coefficients of correlation between simple averages of high school subjects and first semester scholarship at Gettysburg and multiple coefficients between same.

Comparing Table XII with Table IX we see that the conclusions drawn from those results may apply here. There is little difference between the multiple coefficients and those derived from simple averages. In five-eighths of the cases the multiple coefficient is slightly larger. However, coefficients based on simple averages range from .516 to .665 with an average of .615. Those based on multiple correlations range from .576 to .659 with an average of .631. All the coefficients are somewhat smaller but, in general, approach those of 1926 at The Johns Hopkins. Of course, no conclusions could be drawn from the fact that those at Gettysburg were based on the class entering in 1926.

TABLE XII
COEFFICIENTS OF CORRELATION BETWEEN SIMPLE AVERAGES OF HIGH
SCHOOL SUBJECTS AND FIRST SEMESTER SCHOLARSHIP AND
MULTIPLE CORRELATION COEFFICIENTS BETWEEN SAME

High school subjects combined	Coefficient with simple average r	Multiple coefficient R
English and Science	.626	.626
English and History	.561	.576
Mathematics and English	.613	.637
Mathematics and Science	.636	.651
Mathematics and Latin	.516	.612
Mathematics, English and History	.656	.648
Mathematics, English and Science	.646	.659
Mathematics, Latin and Science	.665	.641
High School Average	.637	...

B. VANDERBILT UNIVERSITY

The data used in the case of Vanderbilt include the freshman college and entire high school record of all students entering the University in 1927. This year was chosen because prior to this date students from certain affiliated high schools were given the privilege of admission on recommendation of the high school principal accompanied by a statement of the nature and number of high school units passed. Beginning with 1927 every student must present an application showing the grades made on each subject for each year spent in high school, differentiated as to years taken.

The grading system at Vanderbilt is similar to that in the other two institutions. The grades are literal, but the four passing grades are interpreted to be of equal value and cover a range of 10% each.³ However, as teachers are permitted to differentiate by using a plus and a minus sign with each letter, and as these differentiations are recorded, the mid-point of each interval was used in transmuting the letters to a percentage basis.

The school year is divided into three terms. The degree is granted on the completion of a definite number of quantity

³ Bulletin of Vanderbilt University, : Register and Announcements, 1928-29, pp. 53-54, Nashville, Tenn.

hours with grades which must total the same number of quality hours. Calculations were made of the average scholarship for the first term and for the entire first year. Also the number of quality hours, or honor points, made during the first year was calculated for each student.

The reliability of the marking system was determined by getting the coefficient of correlation between the first term's scholarship and each of first year scholarship and honor points. These are shown below :

	Scholarship 1st yr.	Honor points
Scholarship 1st term	.921	.921

A study of the high school records showed, strikingly, a much greater variation in the passing mark and the interpretation of same than was true in the other two situations. This condition may be accounted for by the fact that Vanderbilt draws its students from a wider geographical range than does either of the other two schools, and also larger numbers come from private preparatory schools. Fifty-four per cent of the students entering in 1927 came from private schools and twenty-five per cent from states other than Tennessee. Of the students from Tennessee the largest number came from the two public schools in Nashville, School C, the city high school and School D, the Davidson County High School, located just outside the city. With such large numbers from these two schools, it was comparatively easy to adjust the passing grade to the Vanderbilt standard. That of School C was 65%. This was found to be too high and was reduced to 60%. That of School D, 75% was found to be much too low and was raised to 85%. The two private preparatory schools in Nashville sending the largest numbers to the University were School E, whose passing grade was taken at face value and School F, whose passing grade was raised to 80%. The passing grades of the private schools in which few students were prepared were taken at face value, and finally the passing grades of small public high schools in less populous districts were treated as at Gettysburg. After this adjustment all grades were transmuted to a common basis to make

them comparable with the college marks. This final evaluation brought the coefficient of correlation from .370 (between high school average and first semester scholarship using passing grade at face value) to .693.

TABLE XIII
COEFFICIENTS OF CORRELATION BETWEEN HIGH SCHOOL SUBJECTS AND
FIRST TERM SCHOLARSHIP AT VANDERBILT UNIVERSITY

	N = about 100					
	English	History	Mathe- matics	Latin	Science	H. S. average
Scholarship 1st term	.699	.436	.679	.647	.514	.693

Attention is called to Tables V and X. The similarity of coefficients is noticeable. However, those of Vanderbilt are quite a little higher than are those found in the other two schools, with the exception of History and Science, those in Vanderbilt being .436 and .514 respectively while averages of the same in The Johns Hopkins University are .59 and .58. The highest coefficient in Vanderbilt is that of English, .699, while the average coefficient for English in The Johns Hopkins is .57.

TABLE XIV
INTERCORRELATIONS OF HIGH SCHOOL SUBJECTS

	English	Science	History	Latin
Mathematics	.614	.527	.468	.665
English	....	.605	.618	....
Science	....	....	....	.464

From Table XV, we note again the similarity between the coefficients based on simple averages and those based on multiple correlation technique. The range of the first is .605-.700 with an average of .672. The range of the multiple coefficients is .699-.782 with an average of .739.

From the Vanderbilt coefficients may be drawn conclusions similar to those in the other two institutions. The coefficients seem to be slightly more consistent and the multiple correlation coefficient is in every case larger than that based on simple average.

TABLE XV

COEFFICIENTS OF CORRELATION BETWEEN SIMPLE AVERAGES OF HIGH SCHOOL SUBJECTS AND FIRST TERM SCHOLARSHIP AT VANDERBILT UNIVERSITY AND MULTIPLE COEFFICIENTS BETWEEN SAME

High school subjects combined	Coefficients with simple averages r	Multiple coefficients R
English and Science	.605	.708
English and History	.639	.699
Mathematics and English	.700	.767
Mathematics and Science	.679	.704
Mathematics and Latin	.689	.728
Mathematics, English and History	.699	.769
Mathematics, English and Science	.694	.782
High School Average	.693	...

Again the combination of three subjects gives in each case a slightly higher coefficient than does the high school average.

CHAPTER VIII

A COMPARISON OF THE JUNIOR-SENIOR HIGH SCHOOL RECORD WITH THE FOUR-YEAR HIGH SCHOOL RECORD

In an earlier chapter, the outline of this study indicated that an attempt would be made to answer two questions. The first of these has been considered, the second will form the basis of this chapter.

Can college success be predicted from a record of the last three years in high school as well as from the entire four-year record?

With the rapid reorganization of public secondary education on the 6-3-3 plan an important question arises in the mind of the college registrar. Shall the entering student present a record of four years' work in the high school or may he be admitted on the presentation of a record of the last three years, in general, the tenth, eleventh, and twelfth grades? Of course it is possible that by the time the college gets adjusted to the junior-senior high school situation secondary education will be well on its way with the 6-4-4 plan. However the question is pertinent at the present time. The senior high school principal frets under the requirement of responsibility for the record of the last year in junior high school, and the college registrar is loath to give up any evidence of college preparation.

The data assembled from the three institutions did not lend itself to the solution of this problem as well as data from some other section might have done, but certain phases of the situation may be considered. Baltimore was rather late in adopting the junior high school plan although the City Department of Education had taken cognizance of the necessity of recognizing individual differences and had adopted a plan for so doing before the junior high school movement was under way. I refer to the preparatory schools organized here

in 1902. These were schools which shortened the elementary course from eight to seven years. At the end of the third year, or the so-called primary school period, the more capable students were admitted to the preparatory schools where the five year preparation for the regular high school was done in four years. The more slowly moving students went on to the grammar school where the work was more suited to each individual and preparation for the high school was done in five years. Junior high schools were established in February, 1919, but there is even yet ninth-grade work carried on in the city high school, though a majority of the students enter City College at the tenth grade from junior high schools.

There are but two junior high schools in Maryland outside of Baltimore City.

This movement reached the South even later than it did Maryland. So Vanderbilt did not yield its quota of data. Gettysburg College does not require that the high school should differentiate, on the application, the work as to years taken so it was impossible to distinguish accurately junior from senior high school work in that case.

An attempt was made to answer the question by the following procedure.

Students entering The Johns Hopkins University were divided into two classes:

1. Those having had four years of preparation in one high school.
2. Those who had taken ninth-grade work in a junior high school.

For the first group coefficients of correlation were determined between first semester scholarship and an average of work done in the last three years, grades 10, 11 and 12. Also first semester scholarship was correlated with an average of all four years. Table XVI indicates the results. High school average scholarship and also the three and four year averages of significant subjects in high school were included. It was necessary to use the students from all three years in one distribution to get a sufficient number for a reliable coefficient.

The results show that, for students from Schools A and B in every case a four year average is a better indication of college scholarship than is the three year one, though this advantage is not pronounced. For students from all schools combined exceptions are in Mathematics and English. Can it

TABLE XVI

COEFFICIENTS OF CORRELATION BETWEEN FIRST SEMESTER SCHOLARSHIP AND AVERAGES FOR THREE YEARS IN HIGH SCHOOL AND FOR FOUR YEARS

GROUP I		
Averages of high school subjects	Schools A and B	All schools
Average 3 years of English	.537	.541
Average 4 years of English	.551	.503
Average 3 years of Latin	.637	.625
Average 4 years of Latin	.682	.658
Average 3 years Mathematics	.288	.464
Average 4 years Mathematics	.426	.421
Average 3 years of History	.237	.423
Average 4 years of History	.413	.582
Average 3 years High School	.660	.611
Average 4 years High School	.695	.652

be possible that the ninth-grade work is more significant than would be expected of an additional factor contributing to an average? To answer this question a comparison was made of the coefficients of correlation between the ninth-grade record and the twelfth-grade record, each with first semester scholarship. This is shown in Table XVII. In only two subjects,

TABLE XVII

COEFFICIENTS OF CORRELATION BETWEEN FIRST SEMESTER SCHOLARSHIP AND FIRST- AND FOURTH-YEAR RECORDS IN HIGH SCHOOL FOR GROUP I

High school subject	Schools A and B	All schools
4th year English	.548	.480
1st year English	.364	.475
4th year Mathematics	....	.325
1st year Mathematics	....	.341
4th year High School Average	.576	.596
1st year High School Average	.602	.605

Mathematics and English, did a sufficient number of students have work in both first and fourth years to make comparisons possible.

Here we see that the ninth-grade average is slightly more significant than the twelfth-grade average, the coefficients being .602 and .576 respectively for Schools A and B, and .605 and .596 for all schools. In Mathematics the same is true for all schools, the coefficients being .341 and .325 respectively. However, English is an exception in both cases being .364 and .548 respectively for Schools A and B and .475 and .480 for all schools. Some authors have advanced the idea that the work of the later years in high school resembles more closely that in college and so is more indicative of the work that a student will do in college than is the work of the earlier years. Beatley¹ at Harvard used the latest high school record in each subject only, and found fairly high coefficients between high school average and first year college standing. (They were not so high as those found in this study.)

It may be possible that the significance of the first year in high school is not due to any similarity of work, method of approach, or mental attitude, but to an ability to cope with the break which occurs between the elementary and high school. Such an ability would operate to overcome the difference in high school and college work. To look further into this matter the group of students who had taken their ninth-grade work in a junior high school were studied. Conclusions drawn from this group are hardly reliable since only 26 such students were available, but we submit the results for what they may be worth in Table XVIII. Correlations of first

TABLE XVIII

COEFFICIENTS OF CORRELATION BETWEEN FIRST SEMESTER SCHOLARSHIP
AND SUBJECTS IN HIGH SCHOOL GROUP 2

High school subject	1st semester scholar
Average 3 years, English	.606
Average 4 years, English	.602
Average 3 years, High School	.779
Average 4 years, High School	.860
9th Grade Average	.716
10th Grade Average	.746
12th Grade Average	.778

¹ Beatley, Bancroft: The Relative Standing of Students in Secondary School, the Comprehensive Entrance Examinations, and in College, School Review, Vol. 30, 1922, pp. 141-147.

semester scholarship with an average of senior high school work, tenth, eleventh and twelfth grades, and also with an average including the ninth-grade were used. This was done for the general average in high school and for English, the only subject carried through the four years by the entire group. Correlations of the first semester scholarship with the averages of each of the following were calculated: ninth-grade (last year of junior high school), tenth-grade (first year of senior high school), and twelfth-grade (last year of senior high school).

The general average for four years gives a coefficient quite a little higher than does that for three years, the coefficients being .860 and .779 respectively, although in English the coefficients are practically the same. When it comes to the individual years we note that the twelfth-grade work is the most significant, the coefficient being .778, and what is perhaps more important, the tenth-grade, the coefficient being .746, is more significant than the ninth, the coefficient being .716. If the ability to bridge the gap between the elementary and high school is the cause of the significance of the marks made the first year of high school, the above condition would follow. But as we have said, this is based on too small a number to yield reliable generalizations.

CHAPTER IX

STATISTICAL TREATMENT

The statistical processes involved in this study have been:

I. COEFFICIENTS OF CORRELATION

The coefficient of correlation is an attempt to measure concomitant variation. Its use is limited to those situations where the relationships are recti-linear. Naturally it represents the relationship most accurately when the data on which it is used lend themselves to measurement by the same or similar units, and when the number of variable factors is small or they are easily controlled. For this reason its use in mental measurements is not so happy as in some other fields, but it is the best method we have, at the present time, of measuring this variation. It is generally conceded by students in this field that the relation between abilities in various subjects is a linear one.

These coefficients were all determined by the Pearson product-moment method, a generally accepted one, an explanation of which may be found in any recognized text book in statistical method. This method is sound when the relationship is linear, regardless of whether or not the distributions are normal.¹

Averages of these coefficients have been used in several cases. The circumstances under which these averages were taken would make them valid. Odell says ² "For predictive purposes, however, if the averages and spreads are not very different, and if each correlation is weighted by the number of cases which contribute to it, the average obtained may be considered fairly representative."

¹ Kelley, T. L.: Statistical Method, New York, Macmillan Company, 1923.

² Odell, C. W.: The Interpretation of the Probable Error and the Coefficient of Correlation, Bureau of Educational Research, University of Illinois, Urbana, Ill., 1926.

2. MULTIPLE CORRELATION COEFFICIENTS

Toops' formula was used for calculating these. This formula was developed by Dr. Herbert A. Toops and has been used by his students in several published studies, but it was obtained directly from Dr. Toops for use in this case. In building up the multiple coefficient one begins with the highest simple coefficient between a subject and the criterion, adds the subject giving the next highest coefficient with the criterion, and to this combination the subject with the third highest coefficient, etc., according to the following formula:

$$r_{ic'} = \sqrt{\frac{r_{ic}^2 + r_{iu}^2 - 2r_{ic}r_{iu}r_{uc}}{1 - r_{uc}^2}}$$

where—

i = the criterion

c' = the combination desired

u = the factor to be added

r_{ic} = combination coefficient with which one starts, at the beginning the highest simple coefficient with the criterion

r_{iu} = correlation of criterion with unique factor

r_{uc} = correlation of combination with unique factor.

This formula is much shorter than that involving partial correlation coefficients.

3. The relationships between scholarship in college and in high school have been based, in this study, on the coefficient of correlation. The ultimate objective in determining these relationships has been the prediction of college success before entrance into college. What is the value of the coefficient of correlation in prediction, and how may it be interpreted?

Taking up the second part of the question first, there are several ways of interpreting a coefficient of correlation:

(a) By the coefficient of alienation, which is an expression of the percentage of errors that would be made when prediction on a coefficient of correlation is used as contrasted with the errors made on a pure guess. The relation of the

coefficient of alienation to the coefficient of correlation is shown by the formula:

$$k = \sqrt{1 - r^2} \text{ where } k \text{ is the coefficient of alienation.}$$

To illustrate this, if $r = .71$, one of the simple coefficient of correlation between high school average and college scholarship found in this study, then

$$k = \sqrt{1 - .71^2} \text{ or } k = .70.$$

In other words, 70% as many errors would be made in predicting college scholarship from high school average as would be made by guessing the college standing. Or the improvement over guessing would be but 30%. However, an improvement of 30% is not to be thrown into the discard. This improvement is sometimes spoken of as the efficiency of the predictive measure, as test or high school record. If E represents the efficiency of any measure in prediction then the efficiency coefficient might be found from the equation

$$E = 1 - \sqrt{1 - r^2}.$$

In interpreting the coefficient of correlation one should be careful not to estimate the percentage efficiency of prediction from the size of the coefficient. As we have seen a coefficient of .71 is only about 30% efficient in prediction. A coefficient of half this size, .35, would have an 8% efficiency. One sees from the nature of the formula that the larger the coefficient the smaller the increase necessary to produce a constant increase in efficiency of prediction. For example, to produce the same increase in efficiency of prediction based on a coefficient of .71 as is the difference in efficiency between prediction on .71 and on .35 would require a coefficient of .88. In other words the predicting efficiency of a coefficient of .35 is 8%, of .71 is 30% and of .88 is 52%.

For purposes of prediction, therefore, it is much more desirable to combine factors which will produce a comparatively small increase in an already existing high coefficient than it would be to produce a much greater increase in a low coefficient.

(b) By another and often used method, that of the probable error of estimate, a measure closely related to the coefficient of alienation, being determined from that measure and the probable error of the criterion. To illustrate, if r = the coefficient of correlation between high school average and college scholarship, and σ = the standard deviation of the distribution of scores on college scholarship then the probable error of estimating college scholarship from high school average would be $P.E._{est} = .6745 \sigma \sqrt{1 - r^2}$. It is interpreted as any other probable error, that is, that half the errors of prediction would be less than and half more than the probable error of estimate.

(c) By the percentage of agreement and disagreement of actual and predicted marks. On the premise that both distributions are normal, the number of predicted measures that would be likely to fall in any given interval (determined from the integral of the probability curve) when based on a coefficient of definite size has been worked out. Such tables may be found in the literature.³ Knowing the number one should expect in every interval, this number may be compared with the number one located in every interval by actual prediction.

The value of the coefficient of correlation in prediction may be illustrated by the following quotation from Clark L. Hull.⁴ In this instance he is discussing college scholarship and intelligence tests, but it is just as applicable here. "The correlation coefficient is an understatement of the percent of agreement or identity of determiners of criteria and tests. This means that with a correlation of .70 between test and criteria there is probably 80 or 85% in common between the causal determiners and the two activities. But the forecasting efficiency is but 29%. Probably a forecasting efficiency of 13% ($r = .50$)

³Hull, Clark L.: The Correlation Coefficient and its Prognostic Value, *Journal of Educational Research*, Vol. 15, 1927, pp. 327-338.

⁴Hull, Clark L.: The Correlation Coefficient and its Prognostic Value, *Journal of Educational Research*, Vol. 15, 1927, pp. 327-338.

is as low as would pay an administrator." The following is his estimate of the value of coefficients of different sizes:

Coefficient	
Below .50	Possibly useless
.50 to .60	Possibly useful
.60 to .70	Of genuine but limited value
.70 to .80	Of decided value but rarely found
Above .80	Not obtained by present methods

Although the ultimate objective of this study is the prediction of college success, it was not the purpose to predict immediately on the coefficients obtained. But rather, the coefficients have been used here to measure the relative value of the high school subjects, offered for admission to college, in the prediction of success. However, if the other two factors which contribute to college success, mentioned at the beginning, should add their proportional parts, beginning with coefficients of correlation as high as those found in this study, a combination of the three factors should yield a coefficient of .80 or above.

CHAPTER X

PROCEDURE DEVELOPED AND INTERPRETATION OF RESULTS

In addition to determining the relative value of the high school subjects in predicting college success we were to attempt to find the best method of handling the high school record. One method of handling it has been developed in the procedure adopted. This procedure may be reviewed at this point. To predict college scholarship from high school marks it is necessary that, as far as possible, every high school shall have the same standard of grading, regardless of the passing mark in the school. We know, from experience, that this is not so. To overcome this variation is one of the registrar's difficulties.

Since the coefficient of correlation is the usual device used for measuring the relationships between marks in high school and in college, for predictive purposes, that interpretation of the high school mark, or what amounts to the same thing, that adjustment of the passing grade, which leads to the highest coefficient of correlation is the one to be made. This is the method adopted here.

To illustrate: The first correlation found was between high school marks, using every passing grade at face value, and college scholarship. From a study of the scatter diagrams those measures which had a tendency to decrease the coefficient could be definitely located in schools of certain classes or types. Then a new passing grade was assigned to this type of school and the coefficient calculated a second time. This was continued until a fairly high coefficient resulted. The procedure was developed on data for the class entering The Johns Hopkins University in 1924. The final interpretations used have been previously shown. The adjustment of high school passing marks based on the data of 1924 was applied, without any changes, to the data for classes entering The Johns Hopkins in 1925 and 1926. This resulted in raising

the coefficient of correlation between high school average and 1st semester scholarship in 1925 from .637 (using passing grade at face value) to .766 (using adjusted passing grade); and in 1926 from .623 to .716. The same procedure was used at Gettysburg College and at Vanderbilt University. Minor changes were necessary because of differences in the bases used for classifying the high schools. At Gettysburg College the coefficient of correlation, between the measures indicated above, was raised from .528 to .637; at Vanderbilt University from .370 to .693.

Any registrar, with records extending over several years, could in this manner determine the standard of all schools, from which his institution admitted students, much more efficiently than was done in this study. An example of using this method is as follows. The students in college were divided into three classes, those who were unsatisfactory or failing students, those who were passing but below the mean of the group, and those who made grades above the mean. The same grouping was made on the high school record, except that before the passing mark was adjusted there were no students in the lowest group. The correspondence between the two sets was calculated, for each situation, before and after the high school passing grade was adjusted.

Before the passing grade was adjusted:

Twenty-one per cent of the Vanderbilt students made unsatisfactory grades during the first semester. Of course, before adjustment of the passing grades none of these fell below passing in high school. After adjustment 30% of these fell below passing in high school, and of those who fell below passing in high school every one failed in college.

The total correspondence was:

Before adjustment—

(a) None were below passing in high school.

(b) Forty per cent ranked below the mean in high school.

(c) Sixty per cent ranked above the mean in high school.

Thirty-one per cent of the Vanderbilt students made satisfac-

tory grades but fell below the mean during the first semester.
Of this number:

- (a) Thirty-eight per cent fell below the mean in high school.
 - (b) Sixty-two per cent fell above the mean in high school.
- Of the students who ranked above the mean in college:
- (a) Eleven per cent fell below the mean in high school.
 - (b) Eighty-nine per cent were above the mean.

After the passing grade was adjusted:
Of the unsatisfactory students in college:

- (a) Thirty per cent failed in high school.
- (b) Sixty per cent made passing grades in high school, but were below the mean.
- (c) Ten per cent were above the mean in high school.

Of the satisfactory students whose grades fell below the mean in college:

- (a) Eighty per cent came from the same group in high school.
 - (b) Twenty per cent came from the group above the mean in high school.
- Of the students who ranked above the mean in college:
- (a) Thirteen per cent fell below the mean in high school.
 - (b) Eighty-seven per cent were above the mean in high school.

An examination of this adjustment of the passing grade from the other point of view reveals that; thirty per cent of the students who made unsatisfactory grades in college could have been definitely located before entrance, for every one of the students who fell below passing after the high school passing mark was adjusted, failed in college and thirty-five per cent of the students who ranked above the mean in high school were reduced to standing between the passing mark and the mean. Of this number 33% were found on the list of unsatisfactory students in college, 50% in the group whose grades were between passing and the mean and only 17% made grades above the mean in college.

It may seem that a thirty per cent reduction in the number of unsatisfactory students is a small one but under present conditions any reduction is to be desired. Apparently this procedure would in no way work a hardship on the applicant, for no excluded student would have made satisfactory college material. On the other hand, a majority of the students would have been located more accurately than otherwise, in so far as their preparation was concerned.

It is probable that the adjustment of the passing grade was more effective in Vanderbilt than in the other schools, because of the variation in the high school situation referred to above. However, the same method was applied to Gettysburg with the following results:

Before adjustment of the high school passing grade, seventeen per cent of the students made unsatisfactory grades during the first year. After adjustment of the passing grades 38% of this number fell below passing in high school and of those reduced to standing below passing every one failed in college.

Total correspondence was:

Before adjustment of the high school passing grade:

(a) Eighty-one per cent were below the mean in high school.

(b) Nineteen per cent were above the mean in high school.

Of students whose college grades were satisfactory, but below the mean in college:

(a) Eighty per cent were below the mean in high school.

(b) Twenty per cent were above the mean.

Of the students above average in college,

(a) Thirteen per cent only were below the mean in high school.

After adjustment of the high school grades:

Of the unsatisfactory students in college,

(a) Thirty-eight per cent failed in high school.

(b) Sixty per cent fell below the mean.

(c) Two per cent only fell above the mean.

Of the satisfactory students who fell below the mean in college,

(a) Eighty per cent were below the mean in high school.

(b) Twenty per cent above the mean.

Of the students ranking above the mean in college,

(a) Twenty per cent fell below average in high school.

From the standpoint of the high school, every student falling below the passing mark after the adjustment failed in college. Nineteen per cent of the students above the mean were reduced in rank to standing below the mean. Of this number, 30% were found on the college failing list, 40% were among those satisfactory students making grades below the mean in college and the other 30% made grades above the average in college.

In this situation the adjustment did not improve the location of the satisfactory student, but slightly disturbed the existing equilibrium. This, however, is of little moment compared with the location of 38% of the unsatisfactory students.

This method of evaluating the procedure was difficult to apply to The Johns Hopkins situation because of the previously mentioned fact that a large per cent of the students, more than half, came from the two Baltimore Schools. However, it was tried out on the class entering in 1925, omitting the students from these two schools. The results were similar to those obtained in the other two institutions. Eighteen per cent of the unsatisfactory students were located and no student would have been refused admission to college who would have been satisfactory college material.

The above evidence would indicate that any college registrar, by painstaking work with records extending over a period of years, can locate students who would prove unsatisfactory in his own institution, much more effectively than is done at the present.

There is nothing new in the recognition of the variability of the high school passing mark and its interpretation. This is probably one reason why practically every college and university has set up a list of affiliated high schools for its own use. However, this has not overcome the variation for

some of the greatest changes made in passing grades were in high schools on the Vanderbilt affiliated list.

Another attempt has been made in the demand for a college certificating grade higher than the passing grade. This is usually set by a regional standardizing agency and adopted in a wholesale manner by all the schools in that section, and is apparently of little help in the situation. It appeared from the records that in none of the institutions studied was the certificating grade operative.

Again one might object to the above procedure because it might add another burden to the administrator. It might be difficult to admit a barely passing student from one high school and refuse admission to the same kind of student from another. On the other hand there is the bare possibility that if a high school principal found his grades discredited he might take the occasion to overhaul his marking system.

Whatever else this state of affairs shows, it certainly emphasizes the need for every high school to scrutinize its own marking system in the light of what other high schools are doing. And though standardization is to be deplored in many ways, a higher degree of uniformity in representing student achievement at the high school level is much to be desired.

CHAPTER XI

SUMMARY OF CONCLUSIONS

A procedure for handling the high school record has been developed. This has proved to be effective in bringing out relationships between scholarship in high school and in college. Coefficients of correlation were used to measure these relationships. The following conclusions may be drawn:

1. There exists a relationship between marks in individual subjects in high school and first-semester and first-year scholarship in college, which may be represented by a coefficient of correlation of about .60.

2. There exists a relationship between the high school average and the same scholarship which may be represented by a coefficient of about .70.

3. A simple average of any three academic subjects gives a coefficient of correlation similar in size to that given by the high school average.

4. In general, for predictive purposes, the use of the regression equation is but slightly more effective than the use of simple averages. Simplicity of treatment would operate in favor of the latter.

5. Apparently for prediction there is no choice among the academic subjects.

6. There is no evidence of a relationship between marks in a non-academic subject, as drawing, and first-year college scholarship.

7. By an application of this general method of handling the high school record any registrar may bring about, in his own institution, an improvement in the identifying of the unsatisfactory student.

8. For predictive purposes, a record of the entire four years in high school is slightly better than a record of the last three years.

CHAPTER XII

OTHER STUDIES

A number of studies in recent years have dealt with the prediction of scholastic success in college, and have included the high school record as a predictive factor. The results in most cases have been reported in terms of the coefficient of correlation between high school scholarship and college scholarship.

In 1921 in a study of intelligence in twenty-five colleges Terman¹ reported that he found coefficients of correlation between the average of four years in high school and college scholarship ranging from .38 to .74.

In 1922 Beatley² reported a study of 423 freshmen entering Harvard University in 1920-21-22. Using the latest high school record only in each subject, he found a coefficient of correlation, between high school average and college scholarship of $.56 \pm .02$.

In 1923, May³ found a coefficient between high school average and college scholarship of .405.

In 1923, Wood⁴ while investigating the use of intelligence tests as a basis for admission to Columbia University, found the coefficient of correlation between secondary school marks and first year scholarship to be .331 and that between the same and first semester of the second year to be .15.

In 1925, Jordan⁵ reports that he found coefficients ranging from .37 to .59.

¹ Terman, L. M.: *Intelligence Tests in Colleges and Universities, School and Society*, Vol. 13, 1921, pp. 481-94.

² Beatley, Bancroft: *The Relative Standing of Students in Secondary School, on Comprehensive Entrance Examinations, and in College, School Review*, Vol. 30, 1922, pp. 141-147.

³ May, M. A.: *Predicting Academic Success, Journal of Educational Psychology*, Vol. 14, 1923, pp. 428-429.

⁴ Wood, Ben. D.: *Measurement in Higher Education*, New York, World Book Co., 1923.

⁵ Jordan, A. M.: *Student Mortality School and Society*, Vol. 22, 1925, pp. 821-824.

In 1927, Cocking and Haly⁶ reporting a study made at The University of Iowa on students entering college in 1920 and 1921 stated that they found a coefficient between high school marks and freshman grades in college of $.55 \pm .319$.

Chas. W. Odell⁷ has recently made an extensive study in the prediction of college success at The University of Illinois which was published September, 1927. The data on which the work was based are the high school record, intelligence test scores, and freshman college record of 2,000 students. These were from various high schools in Illinois. The college records were from the various colleges which these students entered. Under such circumstances one could hardly expect a high degree of correspondence. Much work was done with a comparison of standing in various high school subjects with that in different college subjects and also averages of these two. Of the 156 such coefficients of correlation, ranging from $-.24$ to $.87$ exactly half were below $.40$, more than eighty per cent below $.50$ and of the seven above $.60$ six were between $.60$ and $.70$, one was $.87$.

In 1928, Jones, at the University of Buffalo,⁸ found correlations between high school average and college scholarship for men and women separately. His results showed for 100 men with average of four years in high school a coefficient with college scholarship of $.43$, for average of the fourth year in high schools coefficient of $.45$; for 55 women, average for four years $.58$ and for the fourth-year average $.63$.

⁶ Cocking, W. D., and Haly, T. C.: Relation of Intelligence Scores to High School and University Marks, Educational Research Bulletin, Vol. 6, 1927, pp. 383-384.

⁷ Odell, Chas. W.: Predicting the Scholastic Success of College Freshmen, Urbana, Ill., Bureau of Educational Research, Bulletin No. 37, 1927.

⁸ Jones, E. L.: Predictions from High School Performances, School and Society, Vol. 27, 1928, pp. 337-340.

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APPENDIX

RELATIONSHIPS BETWEEN SCHOLARSHIP IN HIGH SCHOOL AND IN THE SCHOOL OF ENGINEERING, THE JOHNS HOPKINS UNIVERSITY

When this study was begun, the plan included, among other things, a comparison of the predictive value of the high school record in the College of Arts and Sciences and the School of Engineering. When the data were assembled and classified for treatment, it appeared that the two situations were not comparable, for several reasons.

1. Such large number of students were from the Baltimore Polytechnic Institute, which offers technical preparation quite different in nature from the preparation offered by the usual high school. In 1926 only 15 of the 57 students whose records were usable were from schools other than the Polytechnic Institute. In 1925 only 22 of the 64 were from other schools.

2. Of those who entered the Engineering School from the Polytechnic Institute, a majority had taken the advanced course, from which students were admitted to sophomore standing in the University. Others had taken the college preparatory course and were admitted to freshman standing in the University.

No student who had taken his freshman work in a college other than The Johns Hopkins was included with freshmen in the College of Arts and Sciences so it appeared that to include the second- and first-year students in the School of Engineering in the same group and use this group for comparison with freshmen in the College of Arts and Sciences, would hardly be valid. However, coefficients of correlation between high school subjects and college scholarship, for these students, are shown in Table XIX.

The coefficients for the academic subjects, for School B, are similar to the averages of coefficients for the College of Arts and Sciences. However, with the exception of the high

school average, they are all several points higher. The greatest differences are in mathematics and the sciences for which the coefficients in the School of Engineering are .75 each, while averages for these two subjects in the College of Arts and Sciences are .60 and .58 respectively. Again for all schools these two subjects give the highest coefficients .62 and .73 respectively. On the other hand all other coefficients for all schools, are lower than are averages in the College of Arts and Sciences.

TABLE XIX
CORRELATION BETWEEN HIGH SCHOOL SUBJECTS AND 1ST SEMESTER
SCHOLARSHIP SCHOOL OF ENGINEERING, THE JOHNS
HOPKINS UNIVERSITY, 1926.

High school subjects	School B	All schools	High school subjects	School B
English	.613	.462	Mechanics	.797
History	.649	.473	Electricity	.664
Mathematics	.753	.624	Heat	.655
French	.642	.572	Drawing	.403
Science	.749	.729	Shop	.176
High School Average	.684	.631		

School B offered preparatory work of a technical nature. Coefficients based on marks in these subjects are no higher, with the exception of Mechanics, than are those based on marks in academic subjects. As a matter of fact, Drawing and Shop give coefficients (.403 and .176 respectively) lower than any academic subject.

On the whole it appears that academic subjects, as taught in the technical high school of Baltimore, are as indicative of college success in the School of Engineering as are the technical courses, and that, based on such results as these, prediction in the School of Engineering could be made as accurately as in the College of Arts and Sciences.

VITA

Lena James Hawks was born in Warrenton, N. C., May 10, 1878. Her early education was in private schools. She was graduated from The Girls' Latin School, Baltimore, Md. in 1897 and received the A. B. degree from Goucher College in 1900. She was an instructor and graduate student at Syracuse University in 1906-'07, and received the A. M. degree from Vanderbilt University in 1908. During the year 1911-12 she was a graduate student in the Department of Mathematics at The Johns Hopkins University. At intervals from 1922 to 1928 she was a student in the Department of Education at George Peabody College for Teachers.

From 1900 to 1906 she taught physics and chemistry in a junior college in North Carolina; from 1906 to 1911 the same subjects in the Tubman High School, Augusta, Ga. In 1914 she became Head of the Department of Chemistry and Dean of The Woman's College of Alabama; in 1920, Resident Administrator of Martha Washington College; and in 1922, Head of the Department of Mathematics and Dean of Faculty, Ward-Belmont College.

